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A PROTOTYPE PROCEDURE FOR FACILITY DESIGN REVIEWS.(U)
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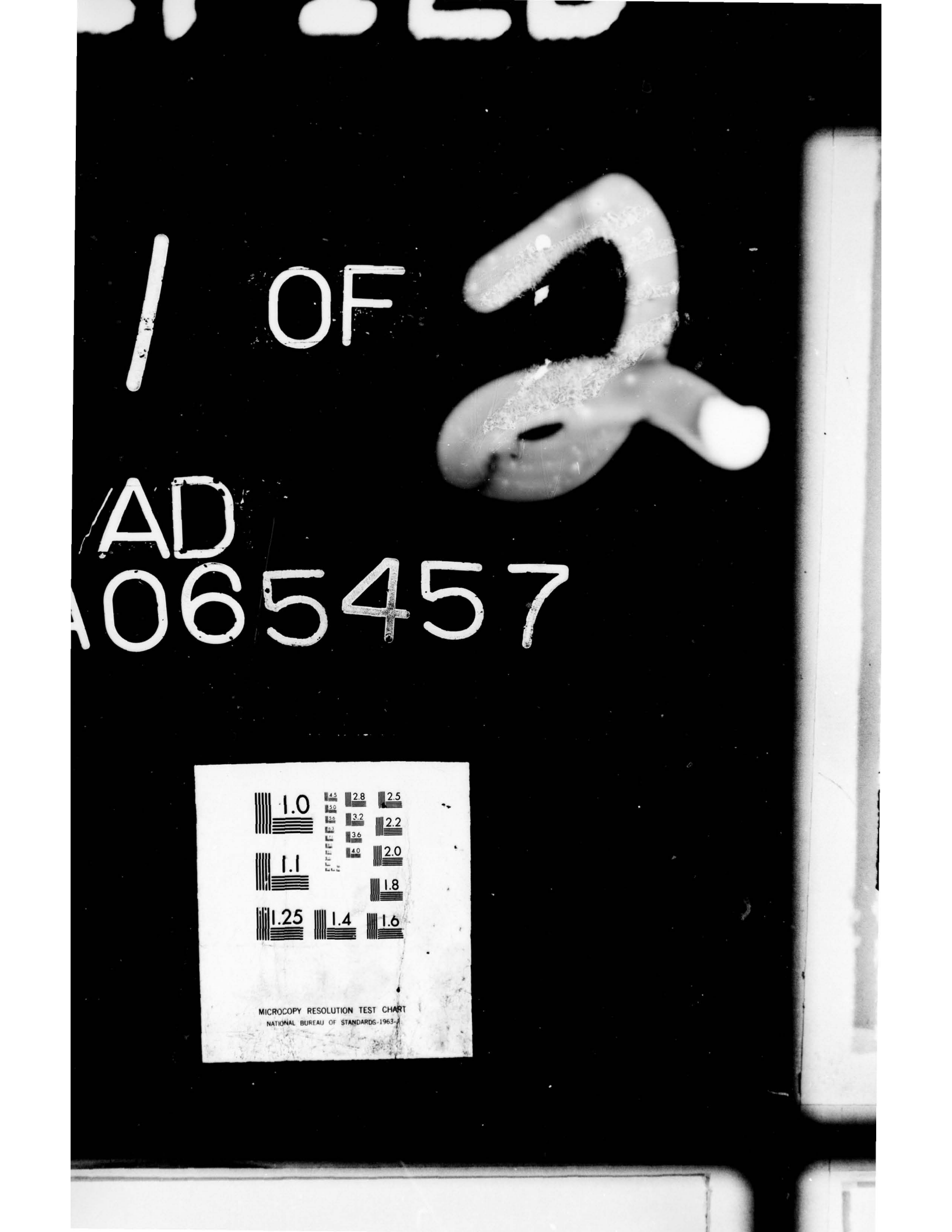
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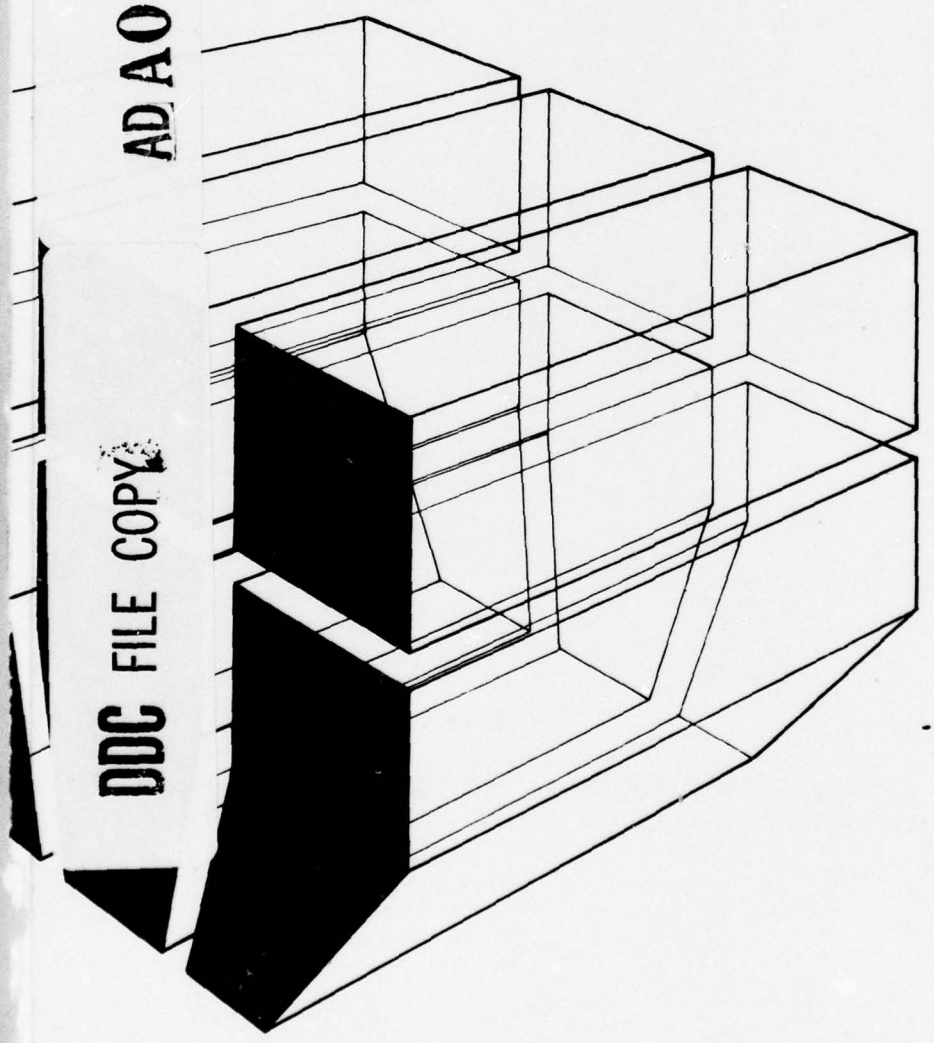
INTERIM REPORT E-145
February 1979
Procedures for Reviewing and Approving Designs for Compliance with Functional Requirements

LEVEL II

A PROTOTYPE PROCEDURE FOR FACILITY DESIGN REVIEWS



by
Roger L. Brauer
David L. Dressel

CERL

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This report covers the initial phase of a study to develop a prototype procedure for the review of the facility designs that will insure that the facility is fully functional when constructed. This report describes who would be involved in the review process, the responsibilities that each party would bear, how the process activities should be ordered, and how major parties would conduct their portions of the review.

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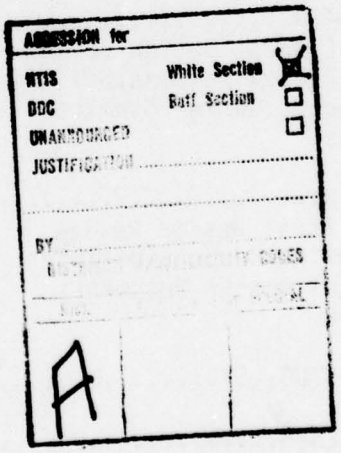
FOREWORD

This investigation was performed for the Directorate of Military Construction, Office of the Chief of Engineers (OCE), under Project 4A762719AT41, "Design, Construction, and Operation and Maintenance Technology for Military Facilities"; Task 03, "Architectural Research and Development in Support of Military Facilities"; Work Unit 004, "Procedures for Reviewing and Approving Designs for Compliance with Functional Requirements." The applicable QCR is 3.10.001. The OCE Technical Monitors were Robert Shibley and Richard Cramer.

This investigation was performed by the Energy and Habitability Division (EH), U.S. Army Construction Engineering Research Laboratory (CERL). The personnel completing the work on this project were Dr. Roger L. Brauer, Principal Investigator, and Mr. David L. Dressel, Associate Investigator.

Mr. R. G. Donaghy is Chief of EH. COL James E. Hays is Commander and Director of CERL, and Dr. L. R. Shaffer is Technical Director.



CONTENTS

A PROTOTYPE PROCEDURE FOR FACILITY DESIGN REVIEWS

1 INTRODUCTION

Background

Current Military Construction-Army (MCA) procedures, in particular AR 415-20 and ER 1110-345-100,[1] specify that the concept designs and final designs for construction projects shall be reviewed. Various organizations are involved in the reviews, depending on the type of facility, the phase of the design, and whether the design is developed by the government or by commercial firms. The reviews are conducted for a number of purposes, such as ensuring economical construction, conservation of energy, environmental protection, and conformance with existing design criteria as well as ensuring that the facility as designed will effectively support the mission and operations of those who will use it.

Related to design reviews are policy statements such as those found in AR 415-15:

"Fewer, larger and more flexible buildings are needed to efficiently house Army functions,"[2] and "Whenever feasible, compatible functions will be combined into single buildings in view of the savings that can be attained by joint use of utilities, circulation space, and other repetitive items."[3] While policies such as these are addressed by architects and engineers in developing a facility design or in conducting reviews, they also form one basis for design review through the value engineering programs (EP 11-1-3)[4] and the application of value engineering methods to entire facility projects.

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1 Project Development and Design Approval, AR 415-20 (Department of the Army [DA], 20 Feb 1969); and Design Policy for Military Construction, ER 1110-345-100 (Office of the Chief of Engineers [OCE], 19 Apr 1974).

2 Military Construction, Army (MCA) Program Development, AR 415-15 (DA, 25 Feb 1977), para 3-1g(2)(b).

3 AR 415-15, para 3-1j.

4 Value Engineering Officer's Operational Guide (OCE, 15 Jun 1976).

Although design reviews are thus identified as necessary steps in the MCA process, several difficulties arise in making them effective, including increased quantity and complexity of requirements, the number of organizational elements involved in review, lack of clarity in review responsibilities, and unavailability of manpower.

The number and complexity of requirements for a project have been increasing. This stems partly from recent legislation on such topics as life safety, energy, environment, accessibility for the handicapped, and historic preservation. Similarly, the using service organizations are demanding facilities that are more mission-responsive and are presenting their requirements in greater detail and with more precision, as reflected in design guides, TOE/TDA programming, and the Project Development Brochure (TM 5-800-3).

Another difficulty arises from the number of organizational elements involved in the review process, each with somewhat different interests and concerns. A review may involve as many as seven major organizations (possibly more in a few cases) and several organizational units within each.

A third difficulty is that organizational elements are often uncertain about what information they are responsible for reviewing. Little guidance or training is provided to individuals for managing their review responsibilities efficiently and thoroughly. Frequently, individuals are biased in their review or have limited perspectives because of their technical background or other factors. Some information undergoes several reviews, while other information is neglected.

Another is simply unavailability of manpower to complete design reviews. Available personnel may already be heavily committed. Staff reductions have affected some organizations, while limitations on additional staff in spite of increasing review burdens have affected others. Thus, more efficient review methods are needed.

The increasing problem of design review in the MCA process means that delivered facilities run a greater risk of not meeting their requirements and are less likely to be mission responsive for users. Because of inflation, providing additional time for review will only add to the cost of a project. While the cost of review may be minimized by letting design review slip, the cost of complying with project requirements will increase in the long run. If the deficiencies in a design solution are not recognized until after the project is constructed or occupied, the cost of retrofits and the resulting inefficiencies of occupying organizations will surely exceed that of making appropriate changes during the design phase.

The project discussed in this report was undertaken to help resolve these problems by developing procedures for evaluating project designs, with the ultimate aim of achieving functional facilities; that is, ones which will effectively support the operations and activities of the users and ensure their health, safety, and satisfaction.

Objective

The overall objective of this study is to develop procedures (1) for reviewing and evaluating facility concept designs, final designs, and value engineering proposals to assess their compliance with the functional requirements of the facility users and (2) for reporting the results of such reviews.

Approach

This study is to be accomplished in three phases: (1) development of prototype procedures, (2) field testing and refinement of the procedures, and (3) development of recommendations for operational procedures and training materials to support the implementation of the procedures. This approach is to be applied to the three review procedures identified: a concept design review, a final design review, and a value engineering study.

This report covers the first phase of study.

Scope

This study is not intended to address all aspects of the three review procedures but is limited to those which influence how well a facility will support the missions and functions of occupants when completed. For example, verifying the structural design is not part of this investigation, but checking such characteristics as the types and quantities of spaces, their arrangements and relationships, and the proper location of design features is considered.

Mode of Technology Transfer

It is anticipated that this work unit will have an impact on ER 1110-345-100, Design Policy for Military Construction; on ER 1110-345-700, Design Analysis; on AR 415-20, Project Development and Design Approval; and on EP 11-1-3, Value Engineering Officer's Operational Guide. The technology will be transferred through training pamphlet(s) and supportive audio-visual packages for reviewer training sessions.

2 SUMMARY OF EXISTING REVIEW PROCESSES

Concept Design Review

According to AR 415-20, for most facility projects* the district engineer forwards the concept design for review to the representative of the using service at the installation (usually defined as the installation commander). The using service has 2 weeks to approve the design or request changes and to obtain all necessary approvals (including the approval of the installation commander if the using service is a tenant).

The concept design submitted for review consists of drawings and data including these items:

1. An area site plan for building groups
2. A project site plan
3. Floor plans showing the functional layout
4. Typical cross sections showing floor-to-floor height
5. Elevations showing principal exterior materials
6. An outline of materials, methods of construction, and finish materials
7. Communication system requirements and a summary of local coordination
8. A description of the heating, ventilating, and air-conditioning (HVAC) systems selected and a summary of decisions
9. Cost estimates for main and supporting facilities.

In addition to the local review, concept designs are reviewed by district engineers as one part of their responsibility (described in ER 1110-345-100, Section 5) for coordinating the interface between the functional requirements of the using service and Army-wide cost controls and design criteria. Districts are responsible for identifying any proposed deviations from standard Army and DOD criteria (ER 1110-345-100, Section 4) and acting on them accordingly.

* Exceptions are repetitive facilities and medical facilities.

Final Design Review

According to AR 415-20, final designs for most projects do not require approval by the using service. However, to provide an informal review and to assure that all approved concept design requirements have been met, the engineer provides an opportunity for in process review of design documents by the using service at some point near the completion of final design.

Upon completion of the final design, the district engineer provides a copy of all bidding documents to the using service and installation commands.

Final designs are given a more thorough review, usually by the district engineer. The reviews (required by ER 1110-345-100) include at least the following:

1. Review of site development design:

    a. to ensure complete and efficient development from an operational and functional standpoint
    b. to determine that it protects and blends with the immediate environment
    c. to establish that it is attractive in appearance

2. Review of the structural design:

    a. to check the size and selection of elements, members, and connections
    b. to check the specifications for them

3. Review of architectural finishes, materials, and components:

    a. for suitability
    b. for harmonious treatment

4. Review of mechanical and electrical design:

    a. for compliance with capacity requirements
    b. for compliance with specified codes
    c. for arrangement

5. Review of other design factors:

   a. concepts for paving and outdoor utilities
   b. spot checking of layout
   c. strength specifications
   d. jointing details and specifications
   e. adequacy of safety, security, antipollution, fire-prevention, and fire-protection features
   f. verification of area and volume calculations
   g. verification that areas do not exceed space allowances
   h. verification of document format and check for discrepancies and inconsistencies within design documents.

In addition, other design review factors become significant at various times and on certain projects. For example, energy and fuel conservation, the seismic aspects of structural design, and environmental protection have received a great deal of attention in recent years.

Value Engineering Reviews

In the review procedures discussed here, value engineering (VE) reviews are normally conducted at the district engineer level. Procedures for implementing VE programs are left to the discretion of each district. General guidelines are outlined in Value Engineering in Construction.[5]

One step in implementing a VE program is to decide whether to undertake a VE study of an item, which may be an entire facility design or any component or subsystem of a facility. In discussing the selection of projects for a VE study, Value Engineering in Construction recognizes several factors:

1. A VE study can be conducted after approved criteria (approved by the Corps of Engineers) or an approved concept (approved by the using service) which satisfies the functional requirements of a project are in existence; i.e., at any time from concept to completion of a project.

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[5] Value Engineering in Construction (Office of the Chief of Engineers, September 1974).

2. A potential savings must exist if a VE study is to be conducted. Thus,
   a. Repetitive designs have a greater savings potential
   b. The savings potential for any project is greatest during concept design and decreases from there on
   c. There may be a point during the development of a project at which the potential cost savings resulting from a VE study will be less than the cost of conducting the study.

3. A decision about conducting a VE study on a project must also consider the availability of personnel to take part in the study and the probability that changes will be implemented.

The second step in a VE program is to choose subjects for study and to conduct VE studies. Some guidance for choosing subjects is provided in Value Engineering in Construction. Detailed procedures for conducting a VE study (the VE Job Plan) are also provided.

3 OVERVIEW OF A PROTOTYPE REVIEW PROCESS

Assumptions

An underlying assumption for the subsequent discussion of modified design review procedures is that the Project Development Brochure (PDB), including the functional requirements of the using service and associated technical data, will be available and will be thorough and comprehensive. Improvements in the preparation of functional requirements by using service organizations have been under development.[6] Implementation of these improvements should make this a valid assumption.

A second assumption is that, for the purposes of this discussion, the proposed review procedures will be manual. However, a computer-assisted review process (referred to as SEARCH) is currently undergoing field tests. Capabilities beyond those being tested are under development. Therefore, it is anticipated that many of the tasks discussed below and assumed to be totally manual will be made more efficient, comprehensive, and accurate as automated tools become available to supplement human capabilities.

It is also assumed that the review procedures proposed below apply to most but not all design projects. For special cases, such as repetitive facilities, hospitals, or complex projects with a high priority, the distribution of review responsibilities and the review sequence would be different from the general case.

Approach

The prototype procedures presented here were derived through analysis of current procedures and from discussions with personnel involved with those review procedures. The prototype procedures have not yet been tested by anyone who would normally use them in conducting a review; thus, they undoubtedly have weaknesses which will have to be corrected in later phases of this project.

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[6] D. L. Dressel, R. L. Brauer, W. D. Veneklasen, and J. H. Burgess, A Prototype Procedure for the Local Generation of Facility Requirements, Interim Report D-80/ADA043172 (Construction Engineering Research Laboratory [CERL], August 1977).

Summary of Processes

The two main phases in the construction process considered here are the concept design review and the final design review. It is assumed that VE activities and studies would most frequently occur within these phases.

The concept design review would involve the district engineer, the major command, and the installation. Figure 1 presents the proposed review process. It indicates who is to be involved in the review of a concept design and the information for which each party should be responsible. The review can be comprehensive and effective if each party understands his* responsibility.

The second phase, shown in Figure 2, would be the review of final designs. The review responsibilities would be similar to those for the concept design review. Emphasis would be placed on examining the detailed information not available during the concept design phase. The involvement of installation personnel would be greatly reduced.

In both the concept design and final design phases, the VE officer is concerned with two issues: identifying candidate VE subjects and determining whether a VE study should be conducted. The significance of functional requirements in conducting VE studies is discussed for the two VE issues in a subsequent section regarding concept and final design reviews.

* Male pronouns are used throughout this report to represent both genders.

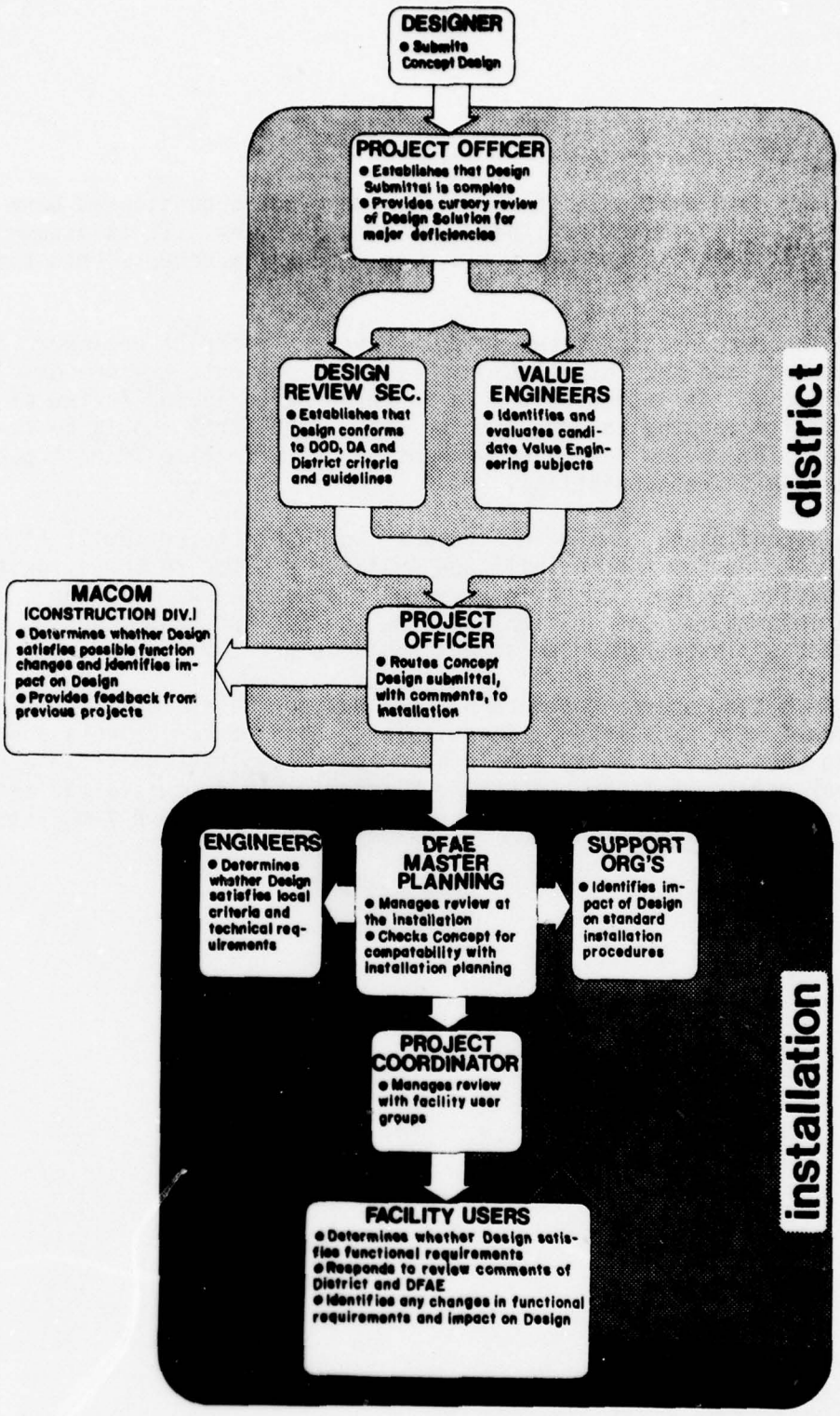

Figure 1. Process for reviewing the concept design.

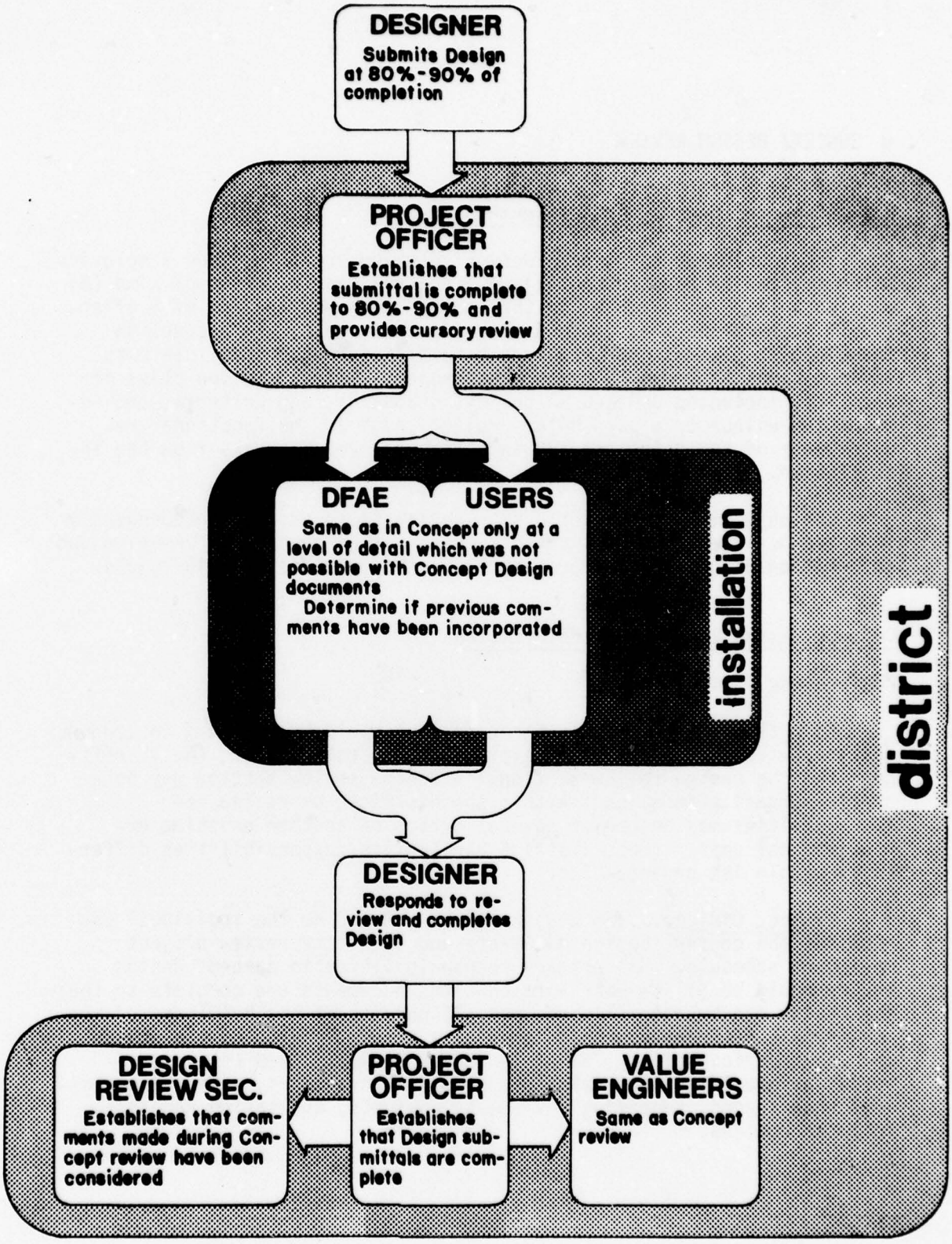

Figure 2. Process for reviewing the final design.

4 CONCEPT DESIGN REVIEW

Objectives for Concept Design Review

The four basic goals of a design solution are to provide a solution which (1) can be constructed (2) within a reasonable period of time (3) at a cost which is at or below the amount budgeted, and (4) will effectively support the missions and operations of users. To accomplish these goals, the designer requires general information applicable to various types of projects or to most projects within a given class of facility, including DOD and DA policy, standards, and criteria; and information unique to a particular project, such as the functional requirements of the using service and technical requirements from the installation.

The objective of concept design review is to assess, independently from the designer, how well the design satisfies general information and information unique for the project in meeting the basic design goals.

Concept Design Review Responsibilities

Engineering District Level

As outlined in Figure 1, three parties would be involved in concept design review at the district level: the project officer, the VE officer, and the design review section. A design review section may be a special organizational unit within the district, or review responsibilities may be one of several duties of another existing organizational unit. (Each district handles its responsibilities differently within its organization.)

Project Officer. The project officer would be the individual who receives the concept design documents and keeps the review project moving on schedule. His primary responsibilities in concept design review would be (1) to make sure that the documents are complete so that the review can be accomplished, and (2) because of his knowledge of key issues as a liaison person, to provide a cursory review of the design for major deficiencies. The project officer would keep the review moving by providing materials to appropriate reviewers, scheduling meetings when needed, receiving reviewers' comments, and taking necessary followup actions.

Value Engineering Officer. The value engineering officer would have two responsibilities at this stage. The first would be to identify candidate value engineering subjects. The subjects could range in scale from the entire design down to some feature or material. Preliminary evaluations of these candidate subjects could be made to determine whether the potential savings were worth the effort of a formal VE study. The second responsibility of the VE officer would be to make preliminary judgments as to whether a formal VE study should be conducted on any of the candidate subjects. This judgment is called preliminary because additional information, comments, or feedback from others involved in the review may be necessary to finalize it.

Design Review Section. Regardless of how the review section is defined or organized within a District office, it would be primarily responsible for establishing that the design solution satisfies the general information, the policies, standards, and criteria of DOD and DA, and to verify that the project can be constructed in a reasonable period of time at or below the budgeted amount. It would also be responsible for judging whether the solution complies with good engineering, design, and construction practices. While the design review section may also wish to review the solution to determine that it satisfies the information unique for the project, such review should not be in depth. This aspect will be reviewed in detail by those who developed and submitted the project-unique information.

Major Command Level

The major command (MACOM) would have a backup role from the facility customer's point of review. The MACOM (usually the Engineering Construction Division or a similar organization) would have three responsibilities in the concept design review process. The first would be to identify possible impacts of the design on long-range mission and function changes. The installation is not always aware of these long-range considerations. Identification of these impacts could result in an extended review of life for a facility.

The second responsibility of MACOM would be to provide feedback from similar projects in other areas of the country. Both the district and the installation may be unaware of the good and bad aspects of past projects of a similar nature.

The third responsibility would be to provide supportive technical guidance to installations where technical expertise may be limited.

Installation Level

At the installation there would be two reviewing parties--the using service and the Directorate of Facility Engineering (DFAE).

Within DFAE are several organizations and individuals who would be involved in the review of a concept design. A major role is that of the master planning office, which provided much of the information unique to the project. Examples of other DFAE organizations involved would be the Utilities and the Buildings and Grounds Divisions. The main responsibilities of DFAE would be (1) to determine whether the technical requirements have been satisfied by the concept design, (2) to manage the review process at the installation, and (3) to respond to comments and issues raised by the district.

The using service also involves several organizations and individuals. These reviewers would be essentially those who were involved in the preparation of functional requirements.[7] The using service would be responsible for (1) determining whether the design satisfies the functional requirements previously submitted, (2) identifying known or anticipated changes in functional requirements and their implications for the design being reviewed, and (3) responding to review comments and issues raised by the district or by DFAE.

Routing the Concept Design Submittal

After the district officer receives the concept design (CD) from the VE, he would forward it concurrently to engineers at the district and the appropriate command headquarters.

After receiving the district and command comments, the project officer would:

1. Send the district's comments to the command
2. Send the command's comments to the district

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[7] D. L. Dressel, R. L. Brauer, W. D. Veneklasen, and J. H. Burgess, A Prototype Procedure for the Local Generation of Facility Requirements, Interim Report D-80/ADA043172 (Construction Engineering Research Laboratory [CERL], August 1977).

3. Send the VE, district, and command comments along with the concept design submissions to the installation master planner.

> (There is no need to forward the PDB, because a copy will have been kept in the master planner's files since its original submission.)

Upon receiving the concept design submission, the installation master planner would perform his review and simultaneously route the concept and Functional Requirements Document (FRD) to the installation engineers and installation support organizations (such as the Buildings and Grounds Division). Comments from these organizations would be added to all preceding comments by the master planner. All comments from all sources, the concept design submission, and the FRD portion of the PDB would then be forwarded to the Project Coordinator. With the Project Coordinator's guidance, the concept design would be reviewed by those who will eventually occupy the facility--members of the using organizations.

Review Procedure

Concept design reviews would take place in three distinct phases: value engineering reviews, review outside the installation, and review within the installation.

Review Outside the Installation

After the value engineer has decided how to address the submission, the design and PDB would be sent to the appropriate command headquarters and to other engineers at the district for review.

The command would use the functional requirements in the PDB as a guide for reviewing the CD. Because the command serves as a filter for many designs for facilities in support of its mission, its broad experience should be especially valuable for judging whether a particular design solution does in fact respond to the stated requirements. The command should also be in a position to review "Forecast" information from the PDB, update it as necessary, and determine whether or not the CD submittal is responsive.

An example of the usefulness of a review by a MACOM would be a situation in which the command is aware of plans that have not yet been communicated to installations. One such case is where an installation is planning a facility for several organizations. The MACOM may be planning to consolidate operations of one of the organizations with similar operations from other installations into one location. A review by the MACOM could thus avoid the construction of unneeded space.

Other cases may involve knowledge of weapons and equipment under development. Knowing that rotors on future helicopters will be a few feet longer than those of current aircraft would allow rotor balancing rooms to be designed to account for this change, avoiding costly retrofits. Also, knowing that future helicopters will have tires whereas current ones do not, would allow users to identify the need for tire maintenance shops.

Examples of a MACOM transferring knowledge gained from a project at one installation to benefit a project at another could also be cited. Consider overhead cranes in tank maintenanace buildings. Because they were left out in one project and the need for them became obvious, the MACOM could alert those involved in similar projects to include them. Or consider the requirement for pits or lifts in vehicle maintenance buildings. The MACOM may have learned that providing pits is very costly when all the safety regulations are met and that, in comparison, lifts are less expensive. Unless alerted by MACOM, local using service organizations may not be aware of this difference in formulating their requirements.

District engineers in their review, would check the concept submittal for compliance with the TM's, ER's, and AR's appropriate for the facility type in question. For more technically oriented facilities, the data for equipment associated with activities documented in the functional requirements will provide a basis for judgments about whether the CD will support the operation of the equipment or will respond to the effects of the equipment operation.

The comments of the command and those of the district would be exchanged after they are submitted to the project officer. This exchange would provide an important means of increasing communication between the two organizations--to show each how the other has judged the concept design.

When the CD is forwarded to the installation for review, the comments from all preceding reviewers would be attached. These comments will give the installation some idea of which design features are likely to be changed--as a result of other comments--and will allow the installation to challenge those ideas that they feel will interfere with the effective functioning of using organizations.

Review Within the Installation

The installation master planner would serve as a review liaison among three review groups: installation support organizations, engineers at the installation (DFAE), and the ultimate facility users.

First, the master planner would review the CD for appropriate siting and aesthetic compatibility with surroundings. He would then forward the CD to DFAE engineers for comparison with local control documents. At the same time, the CD would be sent to installation support organizations so they could assess the impact of the design on their operations. These support organizations may be able to offer suggestions which would make the design solution more compatible with the way the organizations operate.

The last reviewers of the concept design submission would be those organizations, groups, and individuals who will be using the facility. Heading the review team for the users, the project coordinator--preferably the same individual who served as coordinator during the development of the functional requirements[8] --would organize a meeting of representatives of the major using organization. In this meeting, the following questions would be explored:

1. Have the spaces required by each organization been provided in the design?

2. Do the spaces provided for the organizations relate in the manner prescribed in the PDB?

3. Is the solution for the common-use requirements consistent with informal policy? Does the solution conflict with requirements?

4. Are there any possible conflicts about the "ownership" of spaces by organizations?

5. Does the solution adequately accommodate all activity, personnel, and equipment requirements which directly or indirectly impact mission accomplishment?

6. Has any forecast information come into actuality since the requirements were given to the designers? If so, has it been accommodated in the design? What will be the consequences if present concept design solution is implemented?

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8 D. L. Dressel, R. L. Brauer, W. D. Veneklasen, and J. H. Burgess, A Prototype Procedure for the Local Generation of Facility Requirements, Interim Report D-80/ADA043172 (Construction Engineering Research Laboratory [CERL], August 1977).

At their discretion, representatives of the major using organization would meet with their respective subordinate representatives. If no subordinate organizations will be located in the facility, then this meeting could be held with personnel in the major organization. Regardless of the methods used for these meetings, the following questions would be addressed:

1. Do the spaces of subordinate organizations relate to the spaces of the major organizations as stated in the requirements?

2. Does the solution accommodate required relationships among subordinate organizations' spaces?

3. Will the operations and activities (together with personnel and equipment) function properly in the spaces provided? If not, what can be done to the CD so that the spaces will support the activities, personnel, and equipment?

4. Does the solution accommodate all stated requirements? Have any requirements changed or been added since the designers received the PDB?

5. Have stated "needs" been adequately resolved in the CD?

Figure 3 presents several pages from a detailed functional requirement document for an organization called Weather Squadron. As an example, in reviewing a concept design, the Weather Squadron would first look for its spaces (Figure 3b) and determine whether they were interrelated as required (Figure 3b) and also properly related to other organizations (Figure 3c). It would also determine whether the operations for specific spaces, such as the forecast room (Figures 3a, 3d, and 3e), could be accomplished if the facility were constructed as designed. Similarly, the concept design would have to be checked to determine whether the detailed requirements (Figures 3a, 3d, and 3e) were provided. This organization would coordinate with other units in its facility to determine whether overall operations would function properly within the design solution.

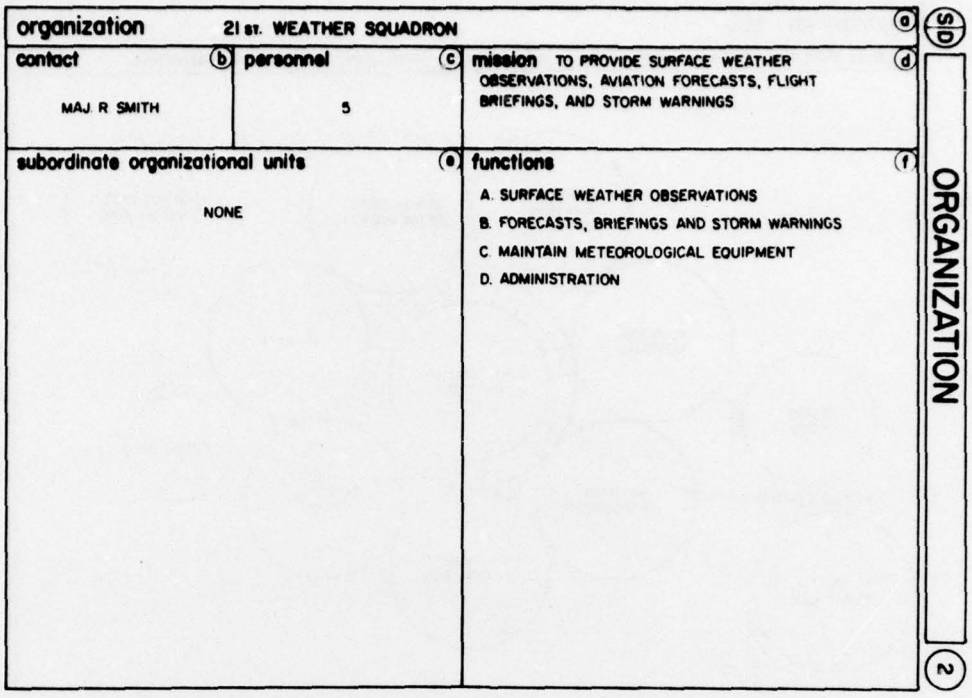

Figure 3a. Summary of Weather Squadron mission, functions, and personnel.

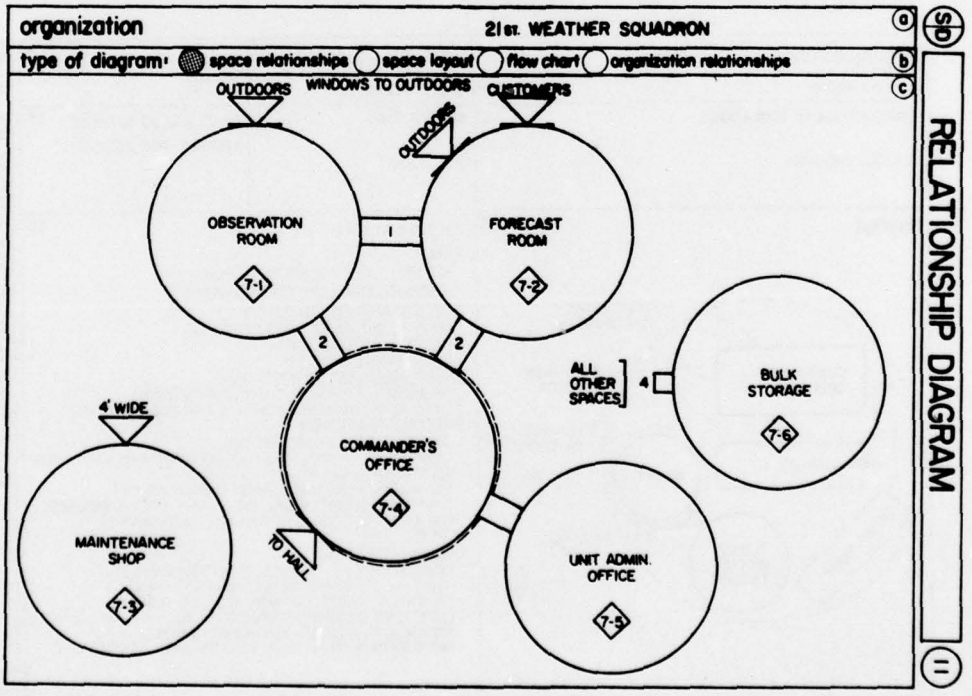

Figure 3b. Relationships among spaces required by the Weather Squadron. Key Requirements are also shown. (See Fig. 3f for key to symbols.)

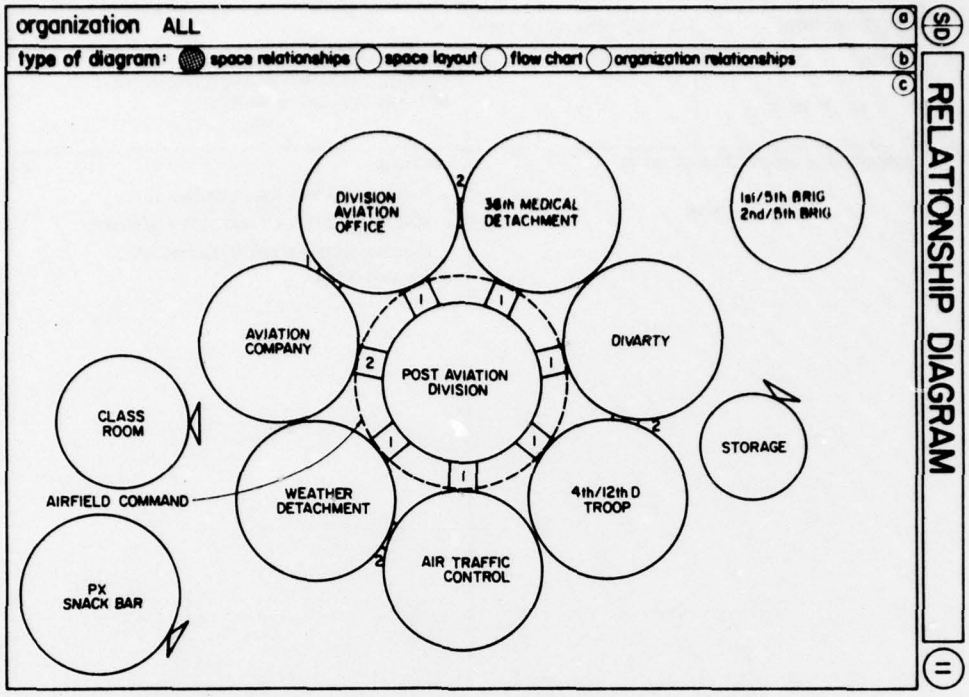

Figure 3c. Relationships among the Weather Squadron and other organizations in the same facility.

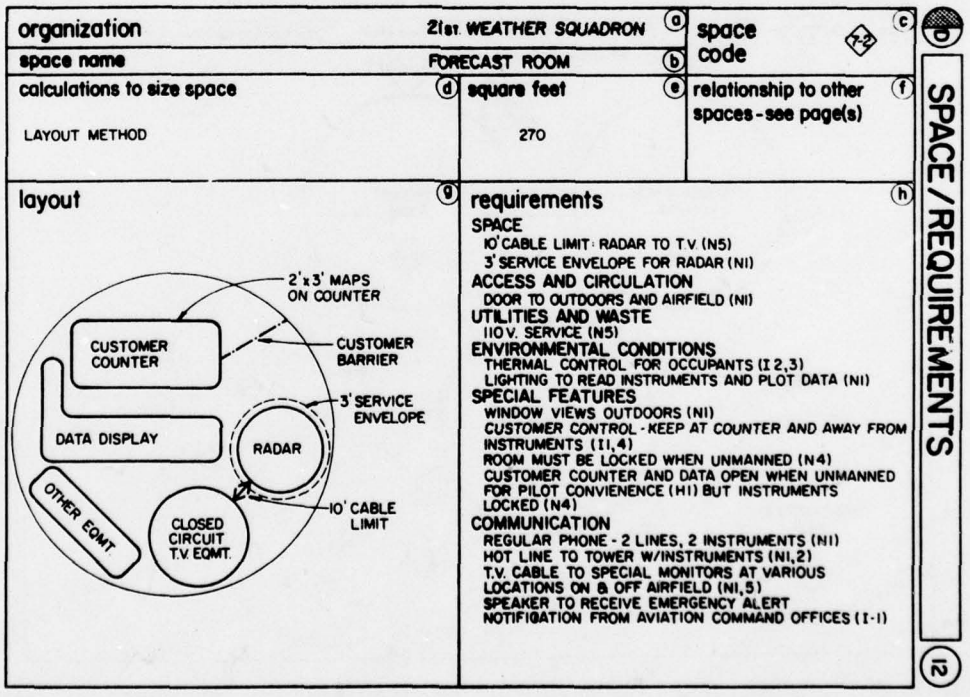

Figure 3d. Space quantity, layout, and other requirements for the forecast room of the Weather Squadron.

activities (i)	personnel (j)	equipment (k)	equipment - special data (l)
B1 DEVELOP FORECASTS	1 PER SHIFT	1 - METEOROLOGICAL RADAR SET (FPS-77)	OUTDOOR ANTENNA
		1 - DATALOG FACSIMILE EQMT.	NOTE 1
B2 BRIEF PILOTS		1 - WESTERN UNION MODEL 40 TERMINAL EQUIPMENT	
B3 TRANSMIT T.V. BRIEFING DATA		1 - AUTOMATIC TELEPHONE ANSERING DEVICE	
		1 - MAP TABLE W/STOOL	3'x 3'
		1 - PLOTTING TABLE W/STOOL	3'x 3'
		1 - CLOSED CIRCUIT T.V. EQMT.	
		1 - WALL DATA AND BRIEFING DISPLAY	40 SQ. FT.
		1 - CUSTOMER COUNTER W/STOOL	APPROX. 2'x 8' STAND-UP HEIGHT

COMMENTS 1. INDOOR INSTRUMENTS; SEE AWSP 105-3 FOR DETAILED INFORMATION (m)
2. OPERATED 2 SHIFTS CURRENTLY

(b) SPACE/CONTENTS (13)

Figure 3e. Contents of the forecast room in terms of activities, personnel, and equipment.

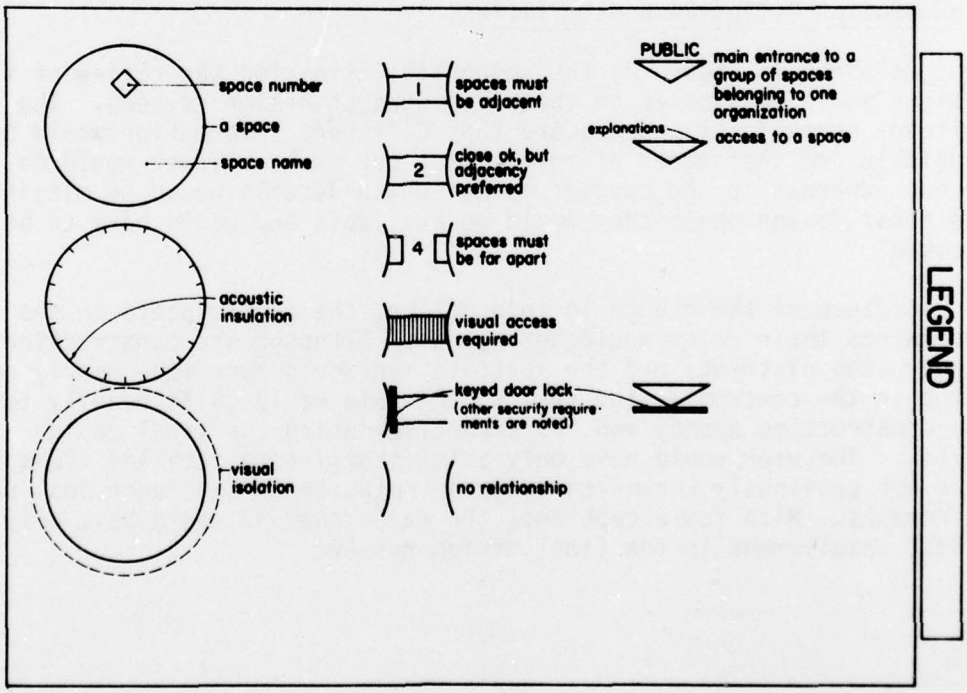

Figure 3f. Key to symbols used in Figure 3.

5 FINAL DESIGN REVIEW

Objectives for Final Design Review

The main objectives for the proposed final design review are:

1. To verify that problems with the concept design have been resolved satisfactorily

2. To determine whether design details satisfy the requirements of the using service and the installation and will effectively support the operational judgment

3. To determine whether design details comply with DOD and DA policies, standards, and criteria

4. To verify that the design and its details have been correctly developed by analysis, computation, and professional judgment

5. To establish whether the design can be constructed

6. To estimate whether the design can be constructed economically.

Final Design Review Responsibilities

As shown in Figure 2, the responsibilities for the review of final designs would be similar to those for concept design reviews. The significant changes, of course, are that different information would be available and the degree of involvement for each reviewer would be altered. Whereas in the concept design phase details would be missing, in the final design phase they would be available and would have to be checked.

Because of the change in information, the participants in the review and their roles would be changed. Although the construction agency (the district) and the installation would have more nearly equal roles in the concept design review, the role would shift heavily toward the construction agency and its expertise during the final design review. The user would have only a few items--some detailed items which were not previously known--to judge in relation to the functional requirements. With few exceptions, the major command would have only slight involvement in the final design review.

Engineering District Level

The district would have a heavy responsibility in the final design review process. The role of the project officer would remain about the same--keeping activities on schedule, acting as the project liaison person, and providing an overview check of the design and its features for major deficiencies.

The role of the value engineering officer would remain the same--identifying candidate VE subjects, evaluating their potential savings, and judging whether VE studies are needed.

MACOM Level

The role of the major command in final design reviews would be very limited. At most it would provide technical backup to the installation in evaluating details of design from the customer's point of view. Occasionally, there may be changes in mission or function anticipated for the future (and not recognized earlier) which may impact on the design or certain of its features.

Installation Level

In the final design review the role of the installation would also be greatly reduced. The installation (represented by technical personnel from DFAE and key persons from the using service) should have the opportunity to briefly review the final design and its detailed features to ensure that: (1) requested modifications in the concept design have been accomplished, and (2) the requirements for detailed features which were not included in the concept design have been satisfied.

Routing the Final Design Documents

When the final design is between 75 and 90 percent complete, the design documents would be sent to the installation for review by DFAE and using service personnel. Following this review, the design documents would be returned to the designer for completion.

Upon completion of final design, the documents would be disseminated to the command and district personnel for final review.

Review Procedure

The review by installation personnel would best be done in a meeting of the master planner, project coordinator, and major using organization representatives. Here, the participants would ensure that requested modifications in the concept design have been addressed and that requirements for detailed features have been met.

At the completion of the final design process, all design documents would be forwarded to the district personnel project officer to determine whether they are complete.

The documents would also be forwarded to the MACOM and distributed internally in the district (to engineers and the VE section). The reviews conducted within the district would be similar to those done during the concept design review except for the fact that the review would be based on more detailed data.

The review at the MACOM would be limited essentially to verifying that comments during the concept design review have been addressed in the final design documents.

6 VALUE ENGINEERING STUDIES

The role of the value engineering officer during concept and final design reviews would be to identify candidate VE subjects, evaluate their potential savings, and judge whether a VE study should be conducted on any of the subjects. The officer may want to form his judgment after receiving comments from others in the district, at the installation, or with a major command. The VE subjects could range from the entire facility down to a small detail.

Once it has been determined that a VE study should be conducted, it is important to note that the functional requirements of the user become a very useful tool. Value Engineering in Construction recognizes that user requirements are one form of data necessary for conducting a VE study. As the users' functional requirements statements are improved, they become more valuable, particularly in Phase I (the information phase) of the VE study. In value engineering studies of facilities, developing functional descriptions and estimating the worth of basic functions depends heavily on the functional requirements of the using service.

In later phases--the speculation phase (Phase II) and the analysis phase (Phase III)--the user requirements are also important. The feasibility of alternate solutions depends on the requirements. In the analysis phase, although the VE study requires that a dollar cost be assigned to each alternative, qualitative aspects must also be considered. Indirect dollar values can be placed on qualitative aspects only with some difficulty. For example, a solution to a health or safety requirement could be valued in terms of the cost of accidents or injuries. Similarly, a solution for a requirement based on morale and satisfaction of personnel could be evaluated monetarily only in terms of the impact on recruitment, retention, training, and other indirect user behaviors.

In the introduction it was noted that fewer, larger, and more flexible buildings are needed to efficiently house Army functions. An example of a VE study which resulted in a solution consistent with this goal involved a training center. The design called for five or six separate buildings in the complex. After proceeding through the five phases of a VE study, the analysis resulted in a solution which combined all operations into one building while meeting the user requirements, reducing cost significantly, and in the opinion of many, achieving a more pleasing appearance.

Other examples could be cited[9] which demonstrate that VE is a useful design review method for reducing cost and yet achieving a solution which satisfies the requirements of using service organizations.

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9 Value Engineering Progress Record, by the U.S. Army Corps of Engineers, May 1976, and Value Engineering Program, May 1977, Progress Report (OCE, 1977).

7 ISSUES FOR FIELD TESTS

The main issue to be addressed in the field tests to be conducted in the next phase of this project is whether the process outlined above can be accomplished in a timely manner and result in effective design reviews. Tests will be conducted to identify general problems which may arise. However, some specific issues must be evaluated through these tests. They include the systematic documentation of review comments and the potential need for comment forms and formats, determining the adequacy of the information available for conducting reviews, identifying tools for increasing review efficiency and effectiveness, and identifying the amount and type of training required for various reviewers.

Documenting Comments

If the comments of one reviewer are to be valuable to another, or if the comments of all reviewers are to be of value to a designer, they must be documented so that they are easily recognized and understood. One goal of the field tests is to find a means for systematically organizing review comments in several ways: according to who made them, according to their subject matter, according to the importance of resolving them, and according to what part of the facility they address.

Determining Adequacy of Available Information

If the responsibilities for reviewing designs are to be accomplished as outlined in previous chapters, the media and substance provided to reviewers must be such that the design and its features are perceived and understood. In the field tests, it will be determined whether drawings, design analyses, specifications, or other forms in which a design is presented are adequate. Inadequacies will be identified and, where feasible, solutions will be suggested or developed.

Identifying Review Aids and Tools

Reviewers may have difficulty with various review tasks. Some tasks may be time consuming, such as searching through criteria documents to see whether the design complies with the regulations. Other tasks may be monotonous, such as checking for certain features room by room. During the field tests, recurring difficulties will be noted, and aids and tools which would improve the quality and efficiency of the review process will be identified. Of particular significance will be noting the areas where computer aids, such as SEARCH, can be applied or their use expanded.

Determining Training Requirements

Some difficulty in completing reviews will result from a lack of knowledge or skill. In each test, the amount and type of training required for reviewers to perform their responsibility will be identified so that appropriate training materials can be developed later in the project.

8 SUMMARY

The purpose of the initial phase of this work unit was to develop a prototype procedure for the review of the facility designs to be sure that the facility will be fully functional when constructed. This report describes who would be involved in the review process, the responsibilities that each party would bear, how the process activities should be ordered, and how major parties would conduct their portions of the review.

The next step will be to test these prototype procedures, refine them in the context of real-world constraints, and develop the training materials needed to make the design review process effective in achieving functional facilities for the customers of the Corps of Engineers.

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35 p. ; 27 cm. (*Interim report ; N-62*)

1. Architecture-designs and plans-reviews. I. Dressel, David L. II. Title. III. Series: U.S. Construction Engineering Research Laboratory. Interim report ; N-62.

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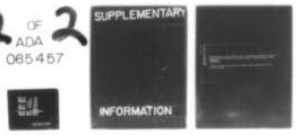

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On the last page of the report, the catalog card, change N-62 to E-145 in lines 5 and 8.